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1-15-04

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re PATENT APPLICATION of

Application No.: 09/760,282

Filing Date: January 12, 2001

Applicant: Koichi Ito et al.

Group Art Unit: 3743

Examiner: John K. Ford

Title: Air Passage Switching Device and Vehicle Air-Conditioner

Attorney Docket: 4041J-000354

verified translat of current priority document

## VERIFIED TRANSLATION OF PRIORITY DOCUMENT

The undersigned, of the below address, hereby certifies that he/she well knows both the English and Japanese languages, and that the attached is an accurate translation into the English language of the Certified Copy, filed for this application under 35 U.S.C. Section 119 and/or 365, of:

| Application No. | Country | Date Filed |
|---|---|---|
| 2000-9966 | Japan | January 13, 2000 |

Signed this 5th day of December, 2003.

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# JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: January 13, 2000

Application Number: Japanese Patent Application No. 2000-009966

Applicant(s): DENSO CORPORATION

December 8, 2000

Commissioner,
Patent Office Kozo Oikawa

Certificate Issuance No. 2000-3101975

| | |
|---|---|
| [Name of Document] | Patent Application |
| [Reference Number] | IP4390 |
| [Filing Date] | January 13, 2000 |
| [Address] | Commissioner of Patent Office |
| [International Patent Classification] | B60H 1/00 |

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| [Indication of Fees] | | |
| [Prepayment Book Number] | 038287 | |
| [Amount of Payment] | 21000 | |
| [List of Submitted Articles] | | |
| [Name of Article] | Specification | 1 |
| [Name of Article] | Drawings | 1 |
| [Name of Article] | Abstract | 1 |

[Name of the Document] Specification

[Title of the Invention]

AIR PASSAGE SWITCHING DEVICE AND VEHICLE AIR CONDITIONER

[Claims]

[Claim 1] An air passage switching device, for opening and closing air passages (22, 23) by means of a sliding door (26) which slides along opening faces of the air passages (22, 23), wherein:

grill members (22a, 23a) dividing up the opening faces of the air passages (22, 23) are formed in the air passages (22, 23), parallel with the sliding direction (a) of the sliding door (26);

the sliding door (26) comprises a film member (26b), for pressing against edge seal faces (22b, 23b) of the air passages (22, 23) and end faces of the grill members (22a, 23a) and for closing the air passages (22, 23), and a door plate (26a) for supporting the film member (26b);

the door plate (26a) is provided with openings (26c) for allowing a draft pressure to act on the film member (26b);

the door plate (26a) further comprises elastic pressing means (26e) for pressing the film member (26b) with an elastic reaction against the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a); and

when the spacing between the door plate (26a) and the end faces of grill members (22a, 23a) in the centers of the air passages (22, 23) in a direction (W) orthogonal to the

sliding direction (a) of the sliding door (26) is written L1 and the spacing between the door plate (26a) and the edge seal faces (22b, 23b) at the ends of the air passages (22, 23) in the same direction (W) is written L2,

L1 and L2 are set in the relationship L1≥L2.

[Claim 2] An air passage switching device according to claim 1, wherein the spacings L1 and L2 are set in the relationship L1>L2 and a maximum value of the spacing L1 is set in a range such that the amount of elastic compression of the elastic pressing means (26e) on assembly of the device is at least 0.

[Claim 3] An air passage switching device according to claim 1 or 2, wherein the elastic pressing means (26e) comprise a plurality of slender elastic pressing means (26e) extending parallel with the sliding direction (a) of the sliding door (26) and disposed only in positions where they face the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a).

[Claim 4] An air passage switching device, for opening and closing air passages (22, 23) by means of a sliding door (26) which slides along opening faces of the air passages (22, 23), wherein:

grill members (22a, 23a) dividing up the opening faces of the air passages (22, 23) are formed in the air passages (22, 23), parallel with the sliding direction (a) of the sliding door (26);

the sliding door (26) comprises a film member (26b),

for pressing against edge seal faces (22b, 23b) of the air passages (22, 23) and end faces of the grill members (22a, 23a) and for closing the air passages (22, 23), and a door plate (26a) for supporting the film member (26b);

the door plate (26a) is provided with openings (26c) for allowing a draft pressure to act on the film member (26b);

the door plate (26a) further comprises elastic pressing means (26e) for pressing the film member (26b) with an elastic reaction against the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a); and

the elastic pressing means (26e) comprise a plurality of slender elastic pressing means extending parallel with the sliding direction (a) of the sliding door (26) and disposed only in positions where they face the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a).

[Claim 5] An air passage switching device according to any one of claims 1 through 4, wherein the film member (26b) comprises a film base layer (50) and a low-friction material layer (51) provided on a side of the film base layer (50) to slide over the edge seal faces (22b, 23b) and the end faces of the grill members (22a, 23a).

[Claim 6] An air conditioner for use in a vehicle, comprising an air passage switching device according to any one of claims 1 through 5, wherein the sliding door (26) opens and closes a plurality of the air passages (22, 23) for supplying

air to a passenger compartment of the vehicle.

[Detailed Description of the Invention

[0001]

[Field of the Invention]

This invention relates to an air passage switching device for switching air passages by means of a sliding door which slides along opening faces of the air passages, and a vehicle air conditioner using this air passage switching device.

[0002]

[Conventional Art]

In Japanese Unexamined Patent Publication No. H.8-258538, the present applicant previously proposed a device for switching air passages in a vehicle air conditioner by means of a sliding door of this kind. And on the basis of this related art, the present inventors produced for trials and studied an air passage switching device shown in Figs. 10 through 13. Figs. 10 and 12 are sectional views on the line A-A in Fig. 3, Fig. 11 is a sectional view on the line C-C in Fig. 10, and Fig. 13 is a sectional view on the line B-B in Fig. 13.

[0003]

In this trial device, a sliding door 26 has a substantially flat, rectangular door plate 26a and a resin film member 26b supported by this door plate 26a. A flow of air passes through openings 26c provided in the door plate 26a (see Fig. 5) and blows in the arrow b direction onto the film member 26b, and a draft pressure of this airflow acts on the film member 26b.

[0004]

By this draft pressure causing the film member 26b to press against edge seal faces 22b, 23b (Figs. 12, 13) of a port 22 or 23 of a case 120, the port 22 or 23 can be closed. And, by the sliding door 26 being slid in the arrow a direction and the film member 26b thereby being moved away from the port 22 or 23 in the case, the port 22 or 23 can be opened. By this means, it is possible to effect air passage switching.

[0005]

When as mentioned above a film-type sliding door 26 was actually produced for trials and studied, it was found that if the opening area of the ports 22, 23 in the case is large, when the port 22 or the port 23 is closed, a phenomenon of the film member 26b bending greatly and entering the closed port 22 or 23 under the draft pressure in the passage behind it occurs. When this happens, a gap forms between the edge seal faces 22b, 23b of the ports 22, 23 and the film member 26b, and problems arise such as draft leakage occurring and the bent portion of the film member 26b biting into the edge corners of the ports 22, 23 when the sliding door 26 is moved and the force required to operate the sliding door 26 consequently increasing.

[0006]

As a study into overcoming this, grill members 22a, 23a were formed midway across the ports 22 and 23 on the case 120 side, extending in the sliding direction a of the sliding door 26 and dividing the opening faces into two, to suppress bending of the film member 26b. However, when all that is done

is simply to form the grill members 22a and 23a, problems arise such as that the film member 26b impacts the grill members 22a, 23a and produces a striking noise.

[0007]

Accordingly, a construction was conceived wherein elastic pressing members 26e are disposed between the door plate 26a and the film member 26b and at all times the film member 26b is pressed by elastic reactions of these elastic pressing members 26e against the edge seal faces 22b, 23b of the ports 22, 23 and the end faces of the grill members 22a, 23a.

[0008]

By this means it is possible to prevent with the grill members 22a, 23a the phenomenon of the film member 26b bending greatly and entering the ports 22, 23 and it is also possible to prevent with the elastic pressing members 26e problems such as striking noises caused by impacting of the film member 26b onto the grill members 22a, 23a.

[0009]

[Problem for the Invention to Solve]

However, when the operating characteristics of this device produced for trials were evaluated under actual usage conditions, it became clear anew that disagreeable extraneous noise is produced from the film member 26b. And when the mechanism by which this extraneous noise is produced was investigated in detail by experiment, it was found to be as follows.

[0010]

That is, the case 120 forming the ports 22, 23 is molded from resin, and for reasons relating to the molding process it is molded in two parts. D in Fig. 3 denotes the plane on which the case 120 is divided, and in the example shown in Fig. 3 this dividing plane D is set along the grill members 22a, 23a in a position in front of the grill members 22a, 23a. Thus, the case 120 is made by joining together with fastening means (not shown) left and right half-cases 121, 122 shown in Fig. 3.

[0011]

Because they share this kind of dividing plane D, the cross-sectional shape (the cross-sectional shape in a W-direction section, orthogonal to the door sliding direction a) of each of the half-cases 121, 122 is U-shaped. And consequently, there occurs a phenomenon of the parts of the half-cases 121, 122 in the vicinity of the dividing plane D falling in toward the inside of the case due to 'sinking' of the material after the resin molding.

[0012]

Fig. 10 shows the assembled state of the sliding door 26 when these parts in the vicinity of the dividing plane D have fallen in toward the inside of the case. When this kind of assembled state arises, at the parts in the vicinity of the dividing plane D in the middle of the ports, due to the phenomenon of falling in mentioned above, the spacing L1 between the end faces of the grill members 22a, 23a and the upper face of the door plate 26a becomes smaller than the spacing L2 at the

W-direction ends of the ports 22, 23 (L1<L2).

[0013]

Consequently, at the parts in the vicinity of the dividing plane D in the middle of the ports the film member 26b is pressed more strongly than elsewhere, and as a result of this, as the sliding door 26 is repeatedly moved back and forth, a concave permanent distortion develops in the film member 26b.

[0014]

At the intermediate parts of the film member 26b between the grill members 22a, 23a and the W-direction ends of the ports 22, 23 (the section C-C in Fig. 10), because the pressing force of the elastic reactions of the elastic pressing members 26e does not act directly on the film member 26b there, when the film member 26b passes over the edge seal faces 22b, 23b of the ports 22 and 23, the above-mentioned concave permanently distorted part springs up under an elastic reaction of the film member 26b itself and undergoes a warp deformation and makes an extraneous noise (a popping noise).

[0015]

Fig. 11 (a sectional view on C-C in Fig. 10) shows the film member 26b passing over the edge seal faces 22b, 23b of a central grid member 123 of the case 120. The above-mentioned popping noise arises both when the film member 26b passes over the edge seal faces 22b, 23b of the central grid member 123 and when it passes over the edge seal faces 22b, 23b at the door sliding direction a ends.

[0016]

To overcome this, the present inventors produced for trials and studied a device wherein elastic pressing members 26e were added also at intermediate positions on the film member 26b, between the grill members 22a, 23a and the W-direction ends of the ports 22 and 23, to increase the pressing force on the film member 26b. With this it was found that by increasing the pressing force it is possible to prevent the above-mentioned warp deformation of the concave permanent distortion and thereby prevent the production of popping noise.

[0017]

However, it was found that instead, an extraneous noise (a crackling noise) caused by an increase in the frictional force on the film member 26b arises. That is, when a predetermined dust-resistance endurance test in an environment wherein dust is mixed with the delivered air (the endurance test conditions being 20,000 back-and-forth movements of the door under the F3 conditions of JIS D0207) is carried out, the surface of the film member 26b roughens, the surface roughness of the film increases from an initial 0.29$\mu$m RZ to 0.61$\mu$m RZ after the test, and this increase in surface roughness combines with the increase in pressing force to raise the frictional force on the film member 26b.

[0018]

As a result, the surface of the film member 26b undergoes a so-called slip-stick phenomenon, a sawtooth-form fluctuation in friction caused by microscopic slipping and

sticking between the film member 26b and the edge seal faces 22b, 23b on the case side (see part X in Fig. 13), and the film member 26b produces a crackling noise.

[0019]

It is therefore an object of the present invention to prevent the production of extraneous noise (popping noise and crackling noise) by a film member in an air passage switching device using a film-type sliding door.

[0020]

[Means for Solving the Problem]

To achieve the above-mentioned object, an invention of Claim 1 is characterized in that the grill members (22a, 23a) dividing up the opening faces of the air passages (22,23) are provided in parallel with the sliding direction (a) of the sliding door (26); the film member (26b), the door plate (26a) for supporting the film member (26b), the elastic pressing means (26e) for pressing the film member (26b) toward the edge seal faces (22b,23b) of the air passages (22,23) and toward the end faces of the grill members (22a, 23a)by an elastic reaction are provided at the sliding door (26); and when the spacing between the door plate (26a) and the end faces of grill members (22a, 23a) in the centers of the air passages (22, 23) in a direction (W) orthogonal to the sliding direction (a) of the sliding door (26) is written L1 and the spacing between the door plate (26a) and the edge seal faces (22b, 23b) at the ends of the air passages (22, 23) in the same direction (W) is written L2,L1 and L2 are set in the relationship $L1 \geq L2$.

[0021]

Here, because it does not happen that the film member (26b) is pressed excessively strongly at the part thereof in the vicinity of the grill members (22a, 23a), the development of a concave permanent distortion in the film member (26b) can be avoided and popping noise caused by warp deformation of a concave permanently distorted part can thus be prevented.

[0022]

Also, because the production of popping noise can be prevented by means of the spacing setting L1≥L2 as mentioned above, it is not necessary for the number of elastic pressing members (26e) to be increased as discussed above with reference to Figs. 12 and 13 to increase the pressing force on the film member (26b). As a result, because the frictional force between the film member (26b) and the edge seal faces (22b, 23b) and the end faces of the grill members (22a, 23a) can be reduced, the slip-stick phenomenon of the film member (26b) caused by this frictional force increasing can be prevented, and crackling noise from the film member (26b) can thereby be prevented. And, the reduction in frictional force enables the door operating force to be reduced.

[0023]

According to an invention of Claim 2, it is characterized that in Claim 1, the spacings L1 and L2 are set in the relationship L1>L2 and a maximum value of the spacing L1 is set in a range such that the amount of elastic compression of the elastic pressing means (26e) on assembly of the device

is 0.

[0024]

By setting L1 and L2 in the relationship L1>L2 like this it is possible to reduce the frictional force on the film member (26b) and better obtain the effects of Claim 1, and by limiting the maximum value of the spacing L1 to a range such that the amount of elastic compression of the elastic pressing means (26e) on assembly of the device is 0 it is possible to obtain an improved draft leakage prevention effect (see experimental results shown in Fig. 7, to be discussed hereinafter).

[0025] According to an invention of Claim 3, it is characterized that in Claim 1 or Claim 2, the elastic pressing means (26e) comprises a plurality of slender elastic pressing means (26e) extending parallel with the sliding direction (a) of the sliding door (26) and disposed only in positions where they face the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a).

[0026] In this case, because the elastic pressing members (26e) are not disposed in intermediate locations between the grill members (22a, 23a) in the centers of the air passages in the direction (W) orthogonal to the sliding direction (a) and the edge seal faces (22b, 23b) at the ends of the air passages in the same direction (that is, are not disposed midway across openings), as they are in Figs. 12 and 13 discussed above, the frictional force on the film member (26b) can be reduced, and as a result it is possible to prevent crackling noise from the

film member (26b) caused by increasing of the frictional force. And at the same time, the reduction in frictional force makes it possible to reduce the force required to operate the door.

[0027]

An invention of Claim 4 is characterized in that the grill members (22a, 23a) dividing up the opening faces of the air passages (22,23) are provided in parallel with the sliding direction (a) of the sliding door (26); the film member (26b), the door plate (26a) for supporting the film member (26b), the elastic pressing means (26e) for pressing the film member (26b) toward the edge seal faces (22b,23b) of the air passages (22,23) and toward the end faces of the grill members (22a, 23a)by an elastic reaction are provided at the sliding door (26); and the elastic pressing means (26e) comprise a plurality of slender elastic pressing means(26e)extending parallel with the sliding direction (a) of the sliding door (26) and disposed only in positions where they face the edge seal faces (22b, 23b) of the air passages (22, 23) and the end faces of the grill members (22a, 23a).

[0028]

In this case, as in the case of Claim 3, because the elastic pressing members (26e) are not disposed at intermediate locations between the grill members (22a, 23a) in the centers of the air passages and the edge seal faces (22b, 23b) at the edges of the air passages, the frictional force on the film member (26b) can be reduced, and as a result it is possible to prevent crackling noise from the film member (26b) caused

by increasing of the frictional force and at the same time the reduction in frictional force makes it possible to reduce the door operating force.

[0029]

According to an invention of Claim 5, it is characterized that in any one of Claims 1 to 4, the film member (26b) comprises a film base layer (50) and a low-friction material layer (51) provided on a side of the film base layer (50) to slide over the edge seal faces (22b, 23b) and the end faces of the grill members (22a, 23a).

[0030]

In this case, the low-friction material layer (51) positioned on the sliding side further reduces the frictional force on the film member (26b) and thereby more effectively prevents the production of crackling noise from the film member (26b).

[0031] According to an invention of Claim 6, it is characterized that in any one of Claims 1 to 5, the invention provides an air conditioner for use in a vehicle, comprising an air passage switching device, wherein the air passages (22, 23) opened and closed by the sliding door (26) are for supplying air to a passenger compartment of the vehicle.

[0032]

Because the operating space of the sliding door (26) can be made very small compared with that of an ordinary rotary door, the invention can be worked highly effectively as an air passage switching device in a vehicle air conditioner, where

there is a strong need for the device to be made compact.

[0033]

The reference numerals assigned in parentheses to the various means mentioned above indicate correspondence with specific means set forth in preferred embodiments of the invention described hereinafter.

[0034]

[PREFERRED EMBODIMENTS]

(First Preferred Embodiment)

Figs. 1 through 7 show a first preferred embodiment of the invention. A vehicle air-conditioner of this preferred embodiment is a rear seat air-conditioner for air-conditioning a rear seat side space in a vehicle having a large passenger compartment, such as a one box car.

[0035]

Referring firstly to Fig. 1, the reference numeral 10 denotes a rear seat air-conditioner, and the main body of this air-conditioner 10 is mounted in a position near the floor of a rear part of a vehicle between a vehicle outer wall and a vehicle inner wall. The vehicle air-conditioner 10 consists mainly of a blower unit 11 and an air-conditioning unit 12 disposed so as to line up in the front-rear direction of the vehicle.

[0036]

The blower unit 11 is for taking in inside air from the rear part of the passenger compartment to the air-conditioner 10, and in this preferred embodiment the vehicle

air-conditioning unit only takes in inside air. The blower unit 11 has an inside air intake opening (not shown) formed in each of its sides (that is, its ends in the width direction of the vehicle, the direction perpendicular to the paper in Fig. 1).

[0037]

The blower unit 11 has a centrifugal electric blower 13. This blower 13 has a centrifugal fan 14 and a fan motor 14a, and the centrifugal fan 14 is rotatably mounted inside a scroll housing 15.

[0038]

A duct 16 constituting a flow passage extending in the front-rear direction of the vehicle is formed on the downstream side of the scroll housing 15 of the blower unit 11. This duct 16 is for changing from downward to upward the direction of a flow of air delivered by the blower unit 11 and guiding it into an evaporator 17. An outlet part of the blower unit 11 is connected to an inlet part of the air-conditioning unit 12 by this duct 16.

[0039]

The air-conditioning unit 12 is disposed behind the blower unit 11 in the front-rear direction of the vehicle and has a resin case 120 forming an air passage extending upward. Inside the case 120 of the air-conditioning unit 12 are disposed the evaporator 17, which is a heat exchanger for cooling air-conditioning air, and a heater core 18, which is a heat exchanger for heating air-conditioning air and is positioned

on the downstream side of the evaporator 17 in the air flow. The evaporator 17 and the heater core 18 are mounted inside the air-conditioning unit 12 one above the other so that their main faces are roughly horizontal.

[0040]

Thus, air delivered by the blower 13 flows toward the rear of the vehicle through the duct 16 and then is guided into the case 120 of the air-conditioning unit 12. And the delivered air guided into the case 120 changes in flow direction from downward to upward and passes through the evaporator 17 and the heater core 18.

[0041]

The evaporator 17 forms part of an ordinary refrigerating cycle circuit together with a compressor, a condenser, a receiver and a pressure-reducer (not shown), and cools and dehumidifies air inside the case 120 by drawing latent heat of evaporation of a refrigerant from the air. The heater core 18 heats a cool draft cooled in the evaporator 17 with warm water from a vehicle engine (cooling water) as a heat source.

[0042]

In this preferred embodiment, a warm water valve 19 for adjusting a flow of warm water to the heater core 18 is provided in a warm water circuit serving the heater core 18, and the outlet temperature of air entering the passenger compartment is controlled by the flow of warm water to the heater core 18 being adjusted by aperture adjustment of this warm water valve 19.

[0043]

A cool draft bypass passage 20 through which air (a cool draft) having passed through the evaporator 17 can bypass the heater core 18 is also provided in the case 120 of the air-conditioning unit 12. This cool draft bypass passage 20 is opened and closed by a cool draft bypass door 21.

[0044]

In the case 120 of the air-conditioning unit 12, a face port 22 and a foot port 23 are formed on the downstream side of (i.e. above) the heater core 18. The face port 22 is for delivering an air-conditioning draft temperature-adjusted by the heater core 18 toward the upper bodies of rear seat occupants, and is connected by a face duct 24 to rear seat face outlets (not shown) in the ceiling of the vehicle.

[0045]

The foot port 23 is for delivering an air-conditioning draft temperature-adjusted by the heater core 18 toward the feet of rear seat occupants, and is connected by a foot duct 25 to rear seat foot outlets (not shown) positioned at the feet of rear seat occupants.

[0046]

The face port 22 and the foot port 23 constitute air passages of the present invention and are opened and closed by a sliding door 26, whereby it is possible to switch between three ordinary air-conditioning outlet modes: a FACE mode, a BI-LEVEL mode and a FOOT mode.

[0047]

A specific example of this sliding door 26 will now be described, with reference to Figs. 2 through 5. The sliding door 26 slides in the arrow a direction (i.e. the vehicle front-rear direction) shown in Fig. 2 along the air passage opening faces of the face port 22 and the foot port 23 provided in the case 120 of the air-conditioning unit 12. W in Fig. 3 denotes the width (left-right) direction of the vehicle.

[0048]

As shown in Fig. 4 and Fig. 5, the sliding door 26 has a door plate 26a and a film member 26b supported by this door plate 26a. The door plate 26a is formed out of a resin such as polypropylene in the shape of a flat frame with four openings 26c (see Fig. 5). The film member 26b is attached to the upper face (the face on the side of the ports 22, 23) of this door plate 26a so as to cover the four openings 26c in the door plate 26a. The film member 26b has an area larger than either of the ports 22, 23 so that it can close either of the ports 22, 23.

[0049]

This film member 26b is molded from a resin material in the form of a thin film having a certain degree of flexibility, a low frictional resistance, and no permeability to air. Specifically, the film member 26b consists for example of a film of PET (PolyEthylene Terephthalate) of thickness 188$\mu$m. The four openings 26c in the door plate 26a allow a draft pressure inside the case 120 to act on the film member 26b.

[0050]

The specific structure by which the film member 26b is attached will now be described. The film member 26b is molded in a shape such that it has a bent portion 26f at each of its ends in the door sliding direction a, as shown in Fig. 5, and a plurality of slot-shaped fixing holes 26g are provided in each of these bent portions 26f. The same number of fixing pins 26h as there are respective fixing holes 26g are integrally formed projecting from each end of the door plate 26a, and the film member 26b is attached to the door plate 26a by the fixing holes 26g in the bent portions 26f of the film member 26b being fitted over these fixing pins 26h and the tips of the fixing pins 26h then being thermally finished. In Fig. 4, the reference numeral 26i denotes an enlarged part formed at the tip of each of the fixing pins 26h by the thermal finishing.

[0051]

Guide pins 26j are integrally molded projecting from two locations on each side face of the door plate 26a (its left and right end faces in the direction W orthogonal to the door sliding direction a). These guide pins 26j are for guiding the sliding of the sliding door 26 in the arrow a direction. That is, in the case 120 of the air-conditioning unit 12, on the inner walls thereof below the face port 22 and the foot port 23, left and right side horizontal guide channels 27, 28 (Figs. 2 and 3) extending parallel with the door sliding direction a are provided, and the guide pins 26j are fitted slidably in these guide channels 27, 28. As a result, the sliding door 26 is held slidably in the case 120 by the mating between

the guide pins 26j and the guide channels 27, 28.

[0052]

Also, on the lower face of the door plate 26a (the face on the heater core 18 side), a rack 26k extending parallel with the door sliding direction a is formed integrally with the door plate 26a. More specifically, as shown in Fig. 5, this rack 26k is formed on the lower side of a central plate face 26d portion of the door plate 26a.

[0053]

And as shown in Fig. 2, inside the case 120, directly below the sliding door 26 and between the face port 22 and the foot port 23, a rotary shaft 29 is mounted in a direction orthogonal to the door sliding direction a. This rotary shaft 29 is made of resin, and is rotatably supported by bearing holes (not shown) in the walls of the case 120. A pinion 30 is provided on this rotary shaft 29 by integral molding with resin at a central location facing the rack 26k. This pinion 30 is positioned inside the case 120 and meshes with the rack 26k.

[0054]

One end of the rotary shaft 29 projects to outside the case 120, and a driving gear 31 is provided on this projecting part. This driving gear 31 is also molded from resin integrally with the rotary shaft 29. A servo motor 32 constituting a door driving device is mounted on the upper side of the case 120, as shown in Fig. 2, and a sector gear 34 is attached to the output shaft 33 of the servo motor 32. This sector gear 34 meshes with the driving gear 31. By this means, rotation of

the servo motor 32 is transmitted via the sector gear 34 and the driving gear 31 to the rotary shaft 29. And, rotation of the rotary shaft 29 is converted to straight-line motion of the sliding door 26 by the meshing between the pinion 30 and the rack 26k.

[0055]

In this preferred embodiment, a rotary shaft 21a of the cool draft bypass door 21 for opening and closing the cool draft bypass passage 20 is linked by links 35, 36 to a pin 34a of the sector gear 34, and the cool draft bypass door 21 is thereby pivoted in cooperation with rotation position of the sector gear 34.

[0056]

The face port 22 and the foot port 23 of the case 120 of the air-conditioning unit 12 are both substantially rectangular in shape, as shown in Fig. 3, and have respective grill members 22a, 23a formed in their centers. These grill members 22a, 23a extend parallel with the sliding (movement) direction a of the sliding door 26, and divide the opening faces of the ports 22, 23 into two.

[0057]

The four-pane window frame shape of the door plate 26a has plate faces 26d (Fig. 5) extending parallel with the door sliding direction a and facing edge seal faces 22b, 23b of the ports 22, 23 and end faces of the grill members 22a and 23a, and elastic pressing members 26e are fixed by means such as adhesion to these plate faces 26d. These elastic pressing

members 26e are cross-sectionally rectangular and are slender in shape, having a width dimension slightly narrower than the width of each of the plate faces 26d.

[0058]

The thickness t (Fig. 5) of the elastic pressing members 26e in the free state is set larger by a predetermined amount than the spacings L1, L2 (Fig. 6) between the door plate 26a, with the sliding door 26 assembled to the inside of the case 120, and the grill members 22a, 23a and edge seal faces 22b, 23b of the case 120 side. Consequently, when the sliding door 26 is assembled to the inside of the case 120, the elastic pressing members 26e are compressed elastically by a predetermined amount in their thickness t direction.

[0059]

As a result, by an elastic reaction of the elastic pressing members 26e the film member 26b is pressed at all times with a predetermined force against the edge seal faces 22b, 23b of the ports 22, 23 and the end faces of the grill members 22a, 23a.

[0060]

When the air-conditioner is operating, under a draft pressure acting through the openings 26c of the door plate 26a, the film member 26b can press against the edge seal faces 22b or 23b of the port 22 or 23 and the end face of the grill member 22a or 23a and certainly close the port 22 or 23.

[0061]

Because the film member 26b performs a sealing

function like this, the elastic pressing members 26e need only make contact with the film member 26b, and do not slide directly on any face of the case 120, and consequently their durability does not need to be particularly high. Therefore, as long as it is elastic, a cheap material can be used for the elastic pressing members 26e. Specifically, a spongelike porous resin foam material can be used for the elastic pressing members 26e.

[0062]

The case 120 forming the ports 22, 23 is made up of left and right half-cases 121, 122 divided by a dividing plane D (Fig. 3) set alongside the grill members 22a, 23a in a position in front of the grill members 22a and 23a, as discussed above.

[0063]

And because the cross-sectional shape (the cross-sectional shape in the W-direction of Fig. 3) of each of the half-cases 121, 122 is a U-shape, a phenomenon of parts of the half-cases 121, 122 around the dividing plane D falling in toward the inside of the case due to `sinking' of the material after resin molding arises. To avoid this, in this preferred embodiment, in the molding of the half-cases 121 and 122, the molding dies are designed so that the U-shaped cross-sections of the half-cases 121, 122 spread slightly outward of 90°. By this means it is ensured that, even if `sinking' of the material after resin molding arises, the spacings L1 and L2 shown in Fig. 6 maintain the relationship L1>L2.

[0064]

That is, Fig. 6 is a sectional view on A-A in Fig.

3, and in the direction W orthogonal to the door sliding direction a the spacing L1 is the spacing between the end faces of the grill members 22a, 23a positioned in the centers of the ports 22, 23 and the upper face of the door plate 26a and the spacing L2 is the spacing between the edge seal faces 22b, 23b at the W-direction ends of the ports 22, 23 and the upper face of the door plate 26a, and in this preferred embodiment the U-shaped cross-sections of the half-cases 121, 122 are molded so that L1>L2.

[0065]

As a specific design example, the thickness t of the three elastic pressing members 26e in the free state is made t=5mm, and L1 and L2 are set in a predetermined range of up to 4mm so that the post-assembly elastic compression (amount of squashing) of the elastic pressing member 26e positioned at the location of the spacing L1 central in the W-direction becomes 0.6mm to 1.0mm and the post-assembly elastic compression (amount of squashing) of the elastic pressing members 26e positioned at the locations of the edge seal faces 22b, 23b at the W-direction ends becomes 1.1mm to 1.5mm.

[0066]

The operation of this air-conditioner will now be described. By selecting a rotation direction and an amount of rotation of the output shaft 33 of the servo motor 32 it is possible to set freely the position of the sliding door 26 in the arrow a direction, and by this means it is possible to open and close the face port 22 and the foot port 23 and thereby

select the FACE mode, the FOOT mode or the BI-LEVEL mode as desired. And when for example the FACE mode is set, the cool draft bypass door 21 cooperatively opens the cool draft bypass passage 20. And, in the BI-LEVEL mode, the cool draft bypass door 21 may be opened by a predetermined amount to make the face outlet temperature lower than the foot outlet temperature.

[0067]

This preferred embodiment has the following merits in the air passage switching action of the sliding door 26.

[0068]

[1] Grill members 22a, 23a extending parallel with the sliding direction a of the sliding door 26 and dividing the opening faces of the ports 22, 23 are provided in the ports 22 and 23, and these grill members 22a, 23a limit bulging deformation of the middle of the film member 26b.

[0069]

[2] Because the film member 26b is pressed against the edge seal faces 22b, 23b of the ports 22, 23 and the end faces of the grill members 22a, 23a at all times by elastic reactions of elastic pressing members 26e, there is no phenomenon of the film member 26b impacting the edge seal faces 22b, 23b and the grill members 22a, 23a at the start of air delivery.

[0070]

[3] Also, in addition to the above, because the spacing L1 between the upper face of the door plate 26a and the end faces of the grill members 22a, 23a positioned in the centers of the ports 22, 23 in the direction W orthogonal to the door

sliding direction a is made larger than the spacing L2 between the upper face of the door plate 26a and the edge seal faces 22b, 23b at the ends of the ports 22, 23 in the W-direction (L1>L2), it does not happen that the film member 26b is excessively strongly pressed in the vicinity of the grill members 22a, 23a (the vicinity of the dividing plane D).

[0071]

Consequently, a concave permanent distortion can be prevented from arising in the film member 26b, and popping noise caused by warp deformation of a concave permanently distorted part can be prevented.

[0072]

In studies carried out by the present inventors it has been confirmed that even if the spacing L1 central in the W-direction and the spacing L2 at the ends in the W-direction are in the relationship L1=L2 it is possible to avoid excessive pressing deformation of the film member 26b and prevent popping noise. Therefore, all that is necessary is for the spacings L1, L2 to be set in the relationship L1≥L2.

[0073]

[4] Because as described above it is possible to prevent the occurrence of popping noise by means of the spacing setting L1≥L2, it is not necessary to increase the number of elastic pressing members 26e from three to five to prevent popping noise as discussed above with reference to Fig. 11, thereby increasing the pressing force on the film member 26b. As a result, the frictional force between the film member 26b

and the case inner walls can be reduced, and consequently it is possible to prevent a phenomenon of slipping and sticking of the film member 26b caused by this frictional resistance increasing and thereby prevent a crackling noise from the film member 26b.

[0074]

More specifically, as shown in Fig. 6, when three elastic pressing members 26e are disposed to correspond only with the grill members 22a, 23a in the middle of the ports and the edge seal faces 22b, 23b at the W-direction ends of the ports, by setting of the above-mentioned elastic compression (amount of squashing) the average value of the surface pressure between the film member 26b and the case inner wall faces can be kept to about 1.5 $g/cm^2$, whereby crackling noise can be prevented.

[0075]

When on the other hand the number of elastic pressing members 26e is increased from three to five as discussed above with reference to Fig. 12, the average value of the surface pressure between the film member 26b and the case inner wall faces rises to about 4.5 $g/cm^2$, and this causes a crackling noise to arise due to the frictional force on the film member 26b increasing.

[0076]

Fig. 7 is a chart made on the basis of experiments carried out by the present inventors and shows, for a case wherein elastic pressing members 26e of free state thickness t=5mm are

used, the relationship between the post-assembly amount of squashing of the elastic pressing member 26e positioned centrally in the W-direction and the post-assembly thickness of the same elastic pressing member 26e and the amount of draft leakage. Here, (1) in Fig. 7 shows the amount of draft leakage to the face port 22 side in the FOOT mode and (2) shows the amount of draft leakage to the foot port 23 side in the FACE mode.

[0077]

As conditions of the experiment, in the FOOT mode the voltage impressed on the fan motor 14a of the blower 13 was made the maximum voltage (12V) and the blower 13 was thereby operated at its maximum speed (Hi), and similarly in the FACE mode the voltage impressed on the fan motor 14a of the blower 13 was made the maximum voltage (13.5V) and the blower 13 was thereby operated at its maximum speed (Hi).

[0078]

Although in Fig. 3 the opening areas of the face port 22 and the foot port 23 have been shown approximately equal to simplify the drawing, in fact, to increase the face outlet flow, the opening area of the face port 22 is made about 30% larger than the opening area of the foot port 23. And because of this, the FOOT mode draft leakage (1) to the face port 22 side is greater than the FACE mode draft leakage (2) to the foot port 23 side.

[0079] And, as will be understood from the characteristics shown in Fig. 7, by making the post-assembly amount of squashing

of the elastic pressing member 26e positioned centrally in the W-direction at least 0, it is possible to keep the FOOT mode draft leakage (1) to a small amount not greater than the maximum value $Q_1$ of the FACE mode draft leakage (2). From this, it can be seen that limiting the maximum value of the spacing L1 central in the W-direction to a range such that the elastic pressing member amount of squashing equals to 0 is also preferable for suppressing draft leakage.

[0080]

Because the film member 26b can basically perform a sealing function by pressing against the edge seal faces 22b, 23b under a draft pressure, even where the post-assembly amount of squashing of the elastic pressing member 26e positioned centrally in the W-direction is on the minus side (where a gap forms between the elastic pressing member 26e and the film member 26b), draft leakage can be kept down to a value amply smaller than a target leakage $Q_0$.

[0081]

(Second Preferred Embodiment)

Whereas in the first preferred embodiment a case wherein the film member 26b consists of a simple PET (PolyEthylene Terephthalate) film was described, in this second preferred embodiment the film member 26b is made with a two-layer structure consisting of a film base layer 50 and a low-friction material layer 51.

[0082]

That is, a low-friction material layer 51 is provided

integrally with the face of the film base layer 50 to slide against the edge seal faces 22b, 23b and the grill members 22a, 23a of the case 120.

[0083]

Here, the film base layer 50 has about the same thickness (188μm) as the film member 26b of the first preferred embodiment, and as its specific material PET (PolyEthylene Terephthalate), PPS (PolyPhenylene Sulfide) or PEN (PolyEthylene Naphthalate) or the like is suitable.

[0084]

The thickness of the low-friction material layer 51 is about 1.2μm, and as its material a resin having a lower coefficient of friction than the film base layer 50 and having resistance to heat to withstand sliding friction heat is preferable, and specifically silicon resin and fluorine resin and the like are suitable.

[0085]

With this second preferred embodiment, by providing the low-friction material layer 51 on the sliding side of the film member 26b, it is possible to reduce the frictional forces between the film member 26b and the case inner walls and thereby more effectively prevent the production of crackling noise by the film member 26b.

[0086]

(Third Preferred Embodiment)

Fig. 9 shows a third preferred embodiment. Here, a front seat air-conditioning unit 12 disposed behind a dashboard

at the front of a passenger compartment employs as a method for controlling an outlet temperature of air delivered to the passenger compartment an air-mixing method whereby the flow proportions of a warm draft passing through a heater core 18 and a cool draft passing through a cool draft bypass passage 20' bypassing the heater core 18 are adjusted. And as door means of this air-mixing method, a sliding door 26 is used.

[0087]

The specific construction and drive mechanism of this sliding door 26 can be the same as in the first preferred embodiment and therefore will not be described here. In Fig. 9, the reference numeral 38 denotes a center face port; 39 a side face port; 40 a defroster port; 41 a foot port; and 42 a first mode door for opening and closing a passage leading to the center face port 38 and a passage leading to the defroster port 40 and the foot port 41. The reference numeral 43 denotes a second mode door for opening and closing a passage leading to the defroster port 40 and a passage leading to the foot port 41.

[0088]

(Other Preferred Embodiments)

Whereas in the foregoing preferred embodiments the grill members 22a, 23a were provided parallel with the door sliding direction a in only one location in the ports 22 and 23, when the opening areas of the ports 22, 23 are large, grill members 22a, 23a may be provided parallel with the door sliding direction a in more than one location. In this case also, the

elastic pressing members 26e are preferably disposed only in positions corresponding to the grill members 22a, 23a and the edge seal faces 22b, 23b.

[0089]

A sliding door according to the present invention can also be applied to an inside/outside air switching door of a vehicle air-conditioning unit, and further can be applied widely to air passage switching devices in applications other than vehicle air-conditioners.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a schematic sectional view of a rear seat air conditioner for a vehicle according to a first preferred embodiment of the invention.

Fig. 2 is an enlarged view of a detail of Fig. 1.

Fig. 3 is an exploded perspective view of a sliding door driving mechanism shown in Fig. 2.

Fig. 4 is an enlarged perspective view of a sliding door shown in Fig. 3.

Fig. 5 is an exploded perspective view of the sliding door of Fig. 4.

Fig. 6 is a sectional view on A-A in Fig. 3.

Fig. 7 is a graph showing relationships between the amount of squashing of an elastic pressing member and the amount of draft leakage in the first preferred embodiment.

Fig. 8 is a partial sectional view of a film member of a second preferred embodiment.

Fig. 9 is a schematic sectional view of a front seat

air conditioner for a vehicle according to a third preferred embodiment.

Fig. 10 is a detailed sectional view on A-A in Fig. 3 of an air passage switching device produced for trials and studied by the present inventors.

Fig. 11 is a sectional view on C-C in Fig. 10.

Fig. 12 is a detailed sectional view on A-A in Fig. 3 of another air passage switching device produced for trials and studied by the present inventors.

Fig. 13 is a sectional view on B-B in Fig. 3 illustrating a mechanism by which a sliding door produces a crackling noise.

[Explanation of the Reference Numerals]

22… face port

23… foot port

22a, 23a… grill member

22b, 23b… edge seal face

26… sliding door

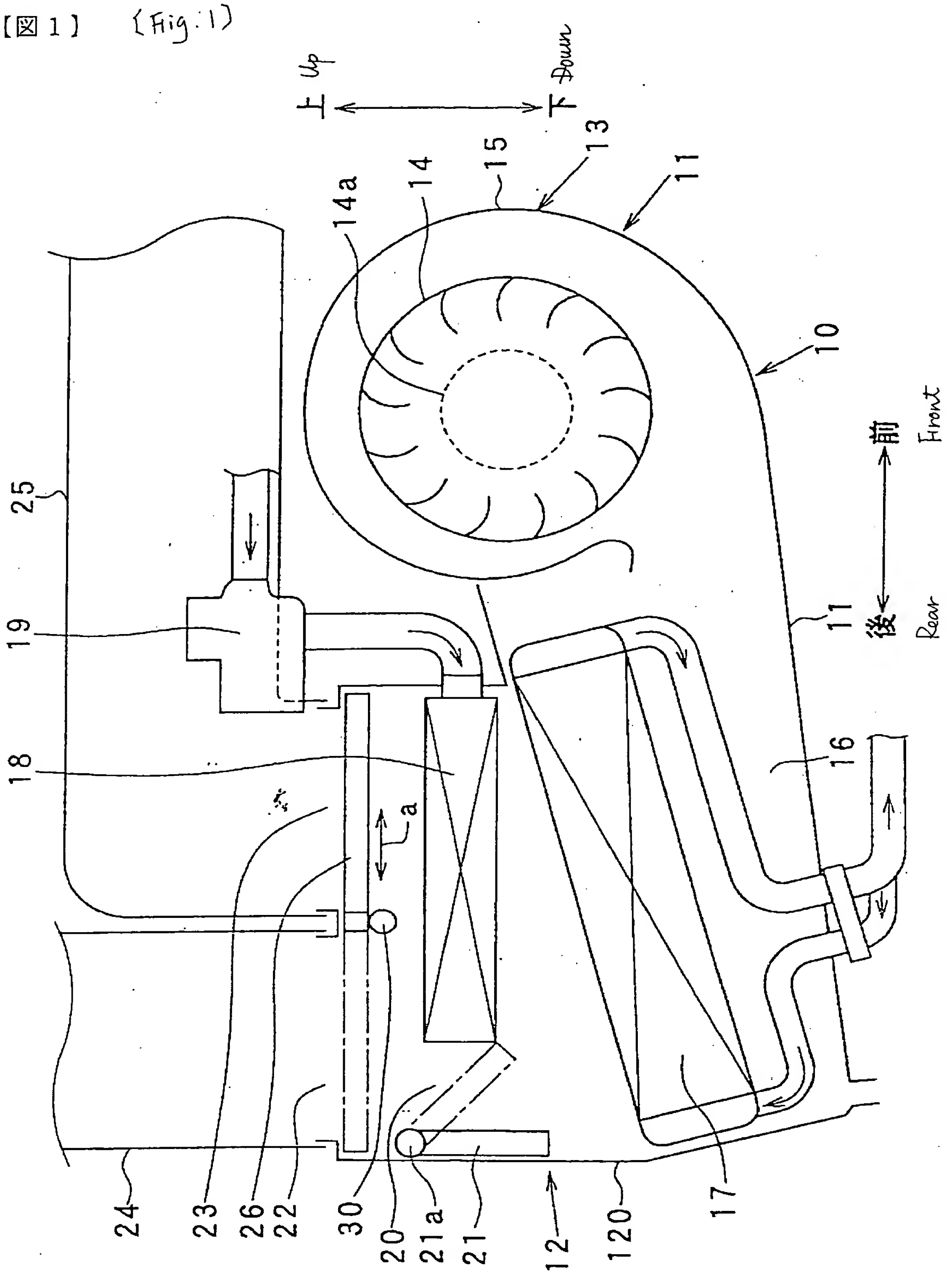
26a… door plate

26b… film member

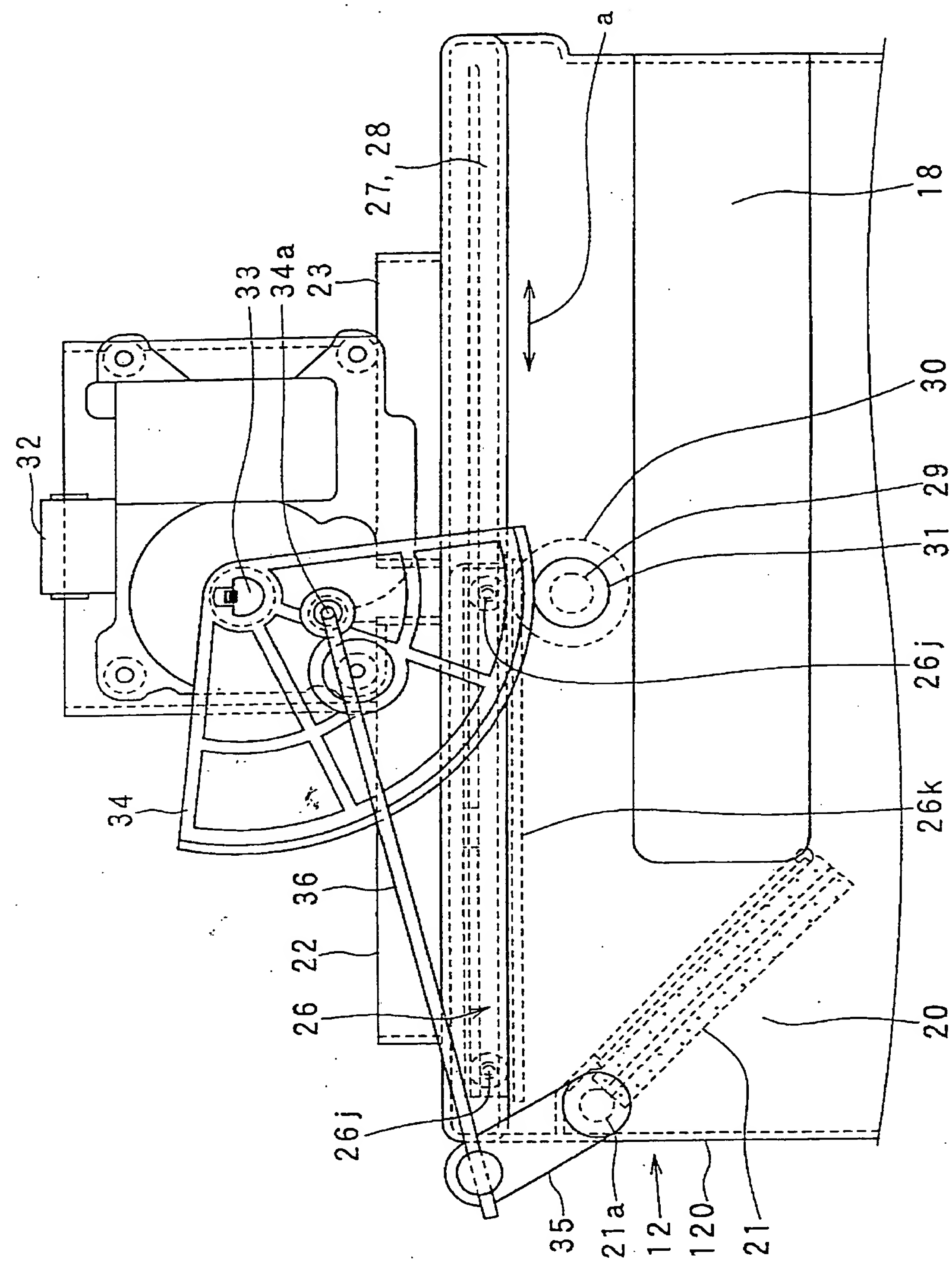
26e… elastic pressing member

【書類名】　　　図面　〔Name of Document〕　Drawings

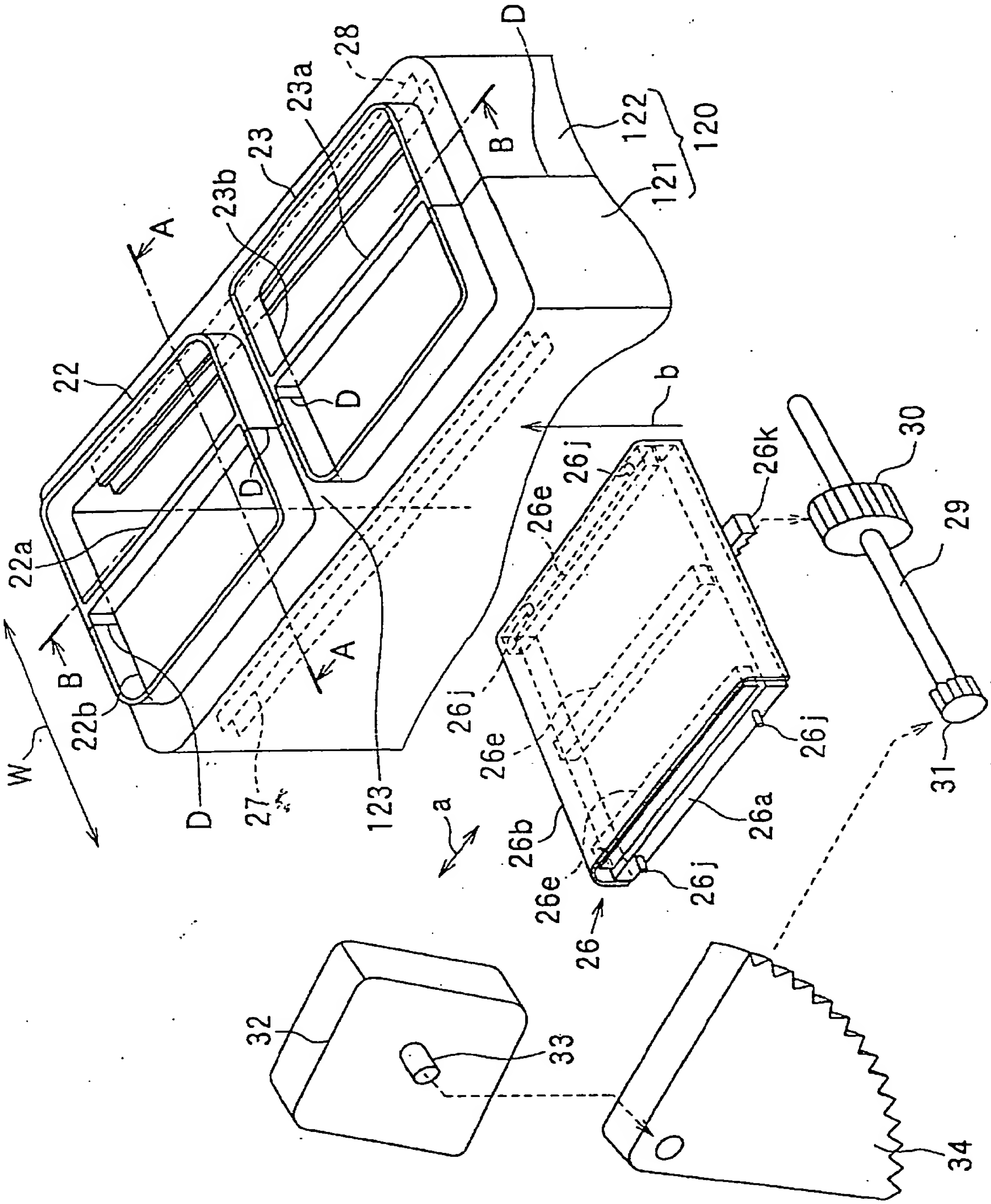
【図１】　〔Fig. 1〕



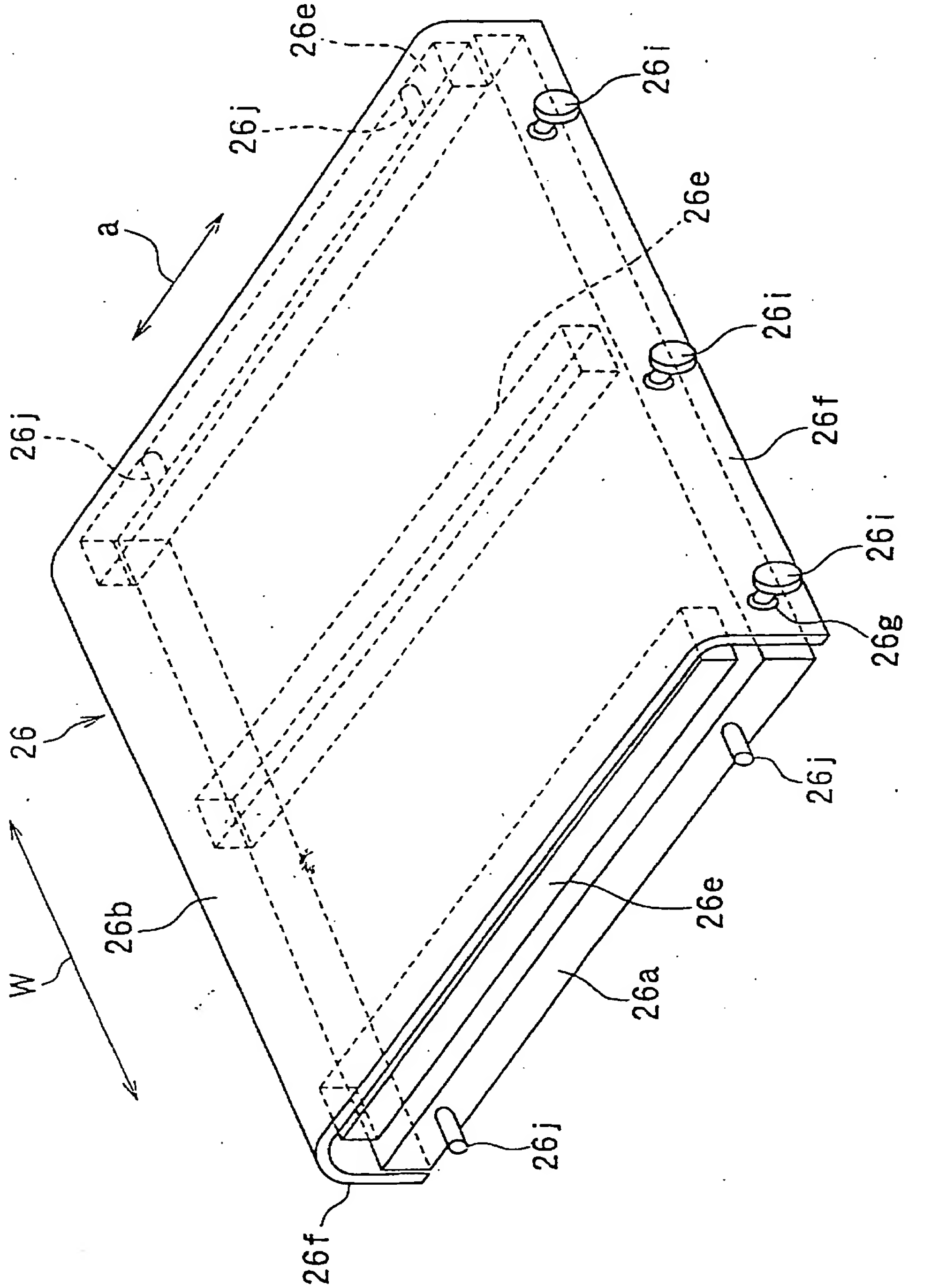
【図２】〔Fig. 2〕


a
27, 28
18
33
34a
23
30
32
29
31
26j
26k
34
36
22
26
20
26j
35
21a
12
120
21

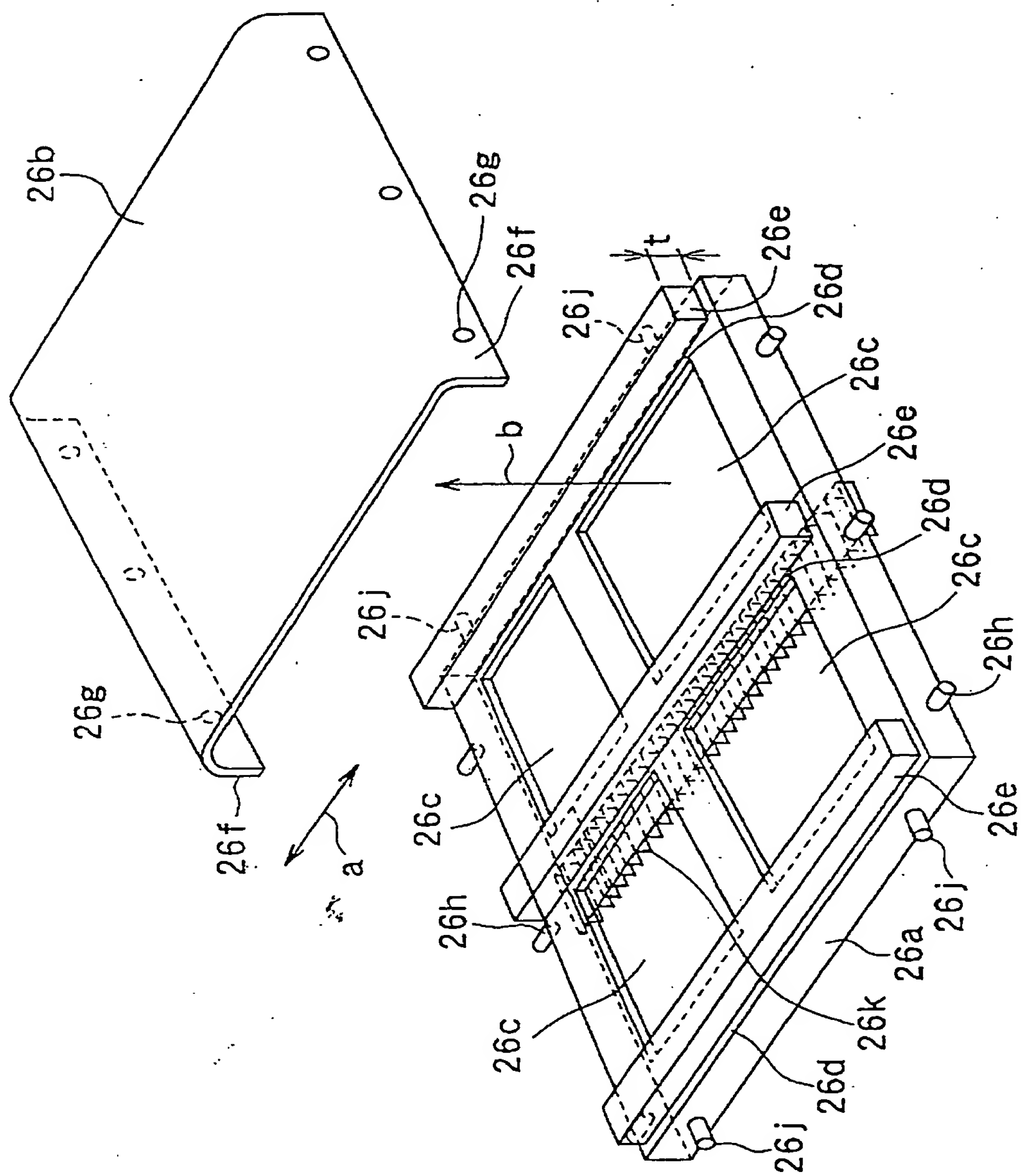
【図３】 (Fig.3)


D
28
23a
122
120
23
B
121
23b
A
22
D
b
D
30
26k
26j
26e
29
22a
B
22b
W
26j
26e
A
26j
D
27
123
a
26b
26a
31
26e
26j
26
32
33
34

【図４】〔Fig.4〕



【図５】{Fig.5}


26b
26g
26f
26e
26d
26j
t
26c
b
26e
26d
26c
26c
26j
26h
26g
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a
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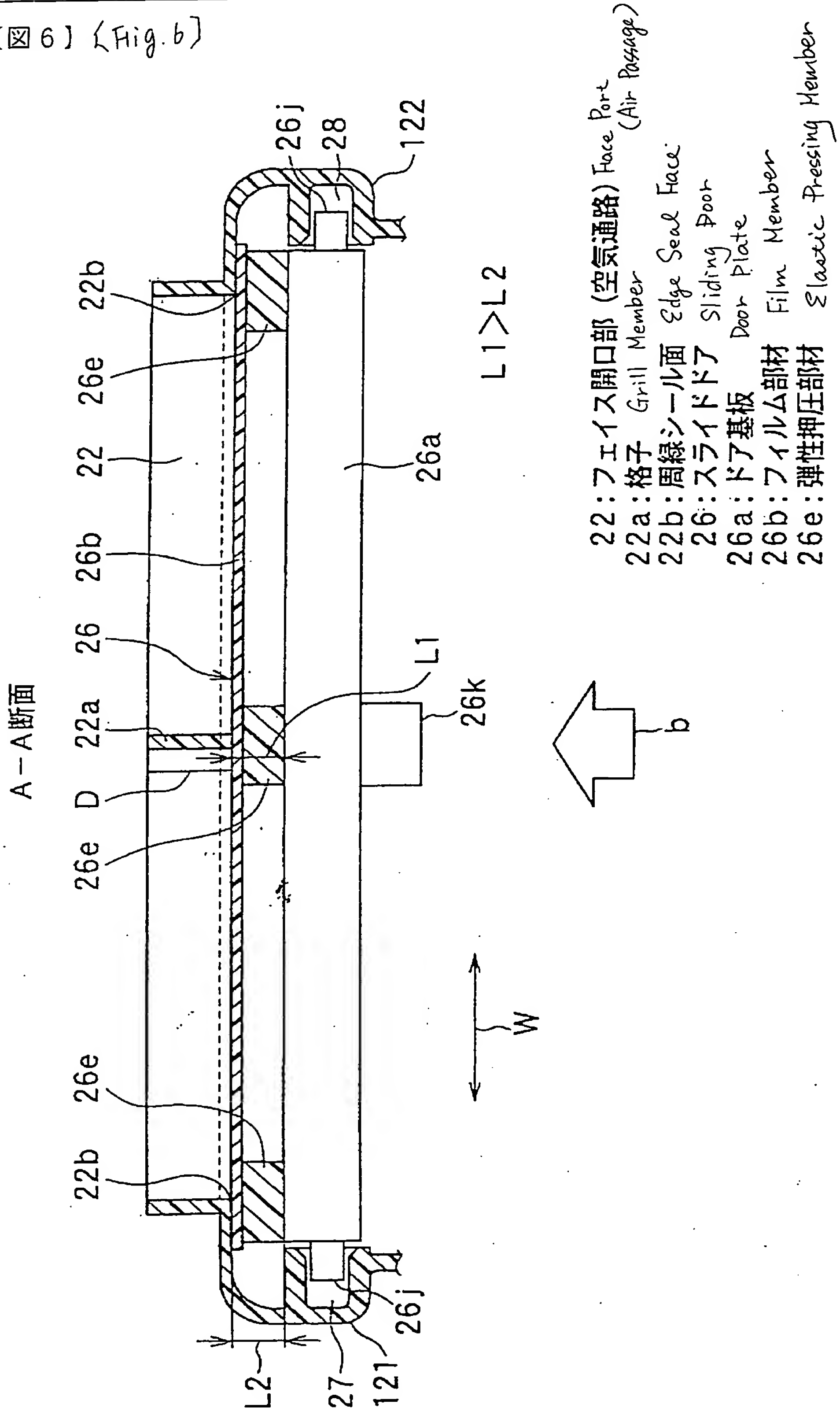
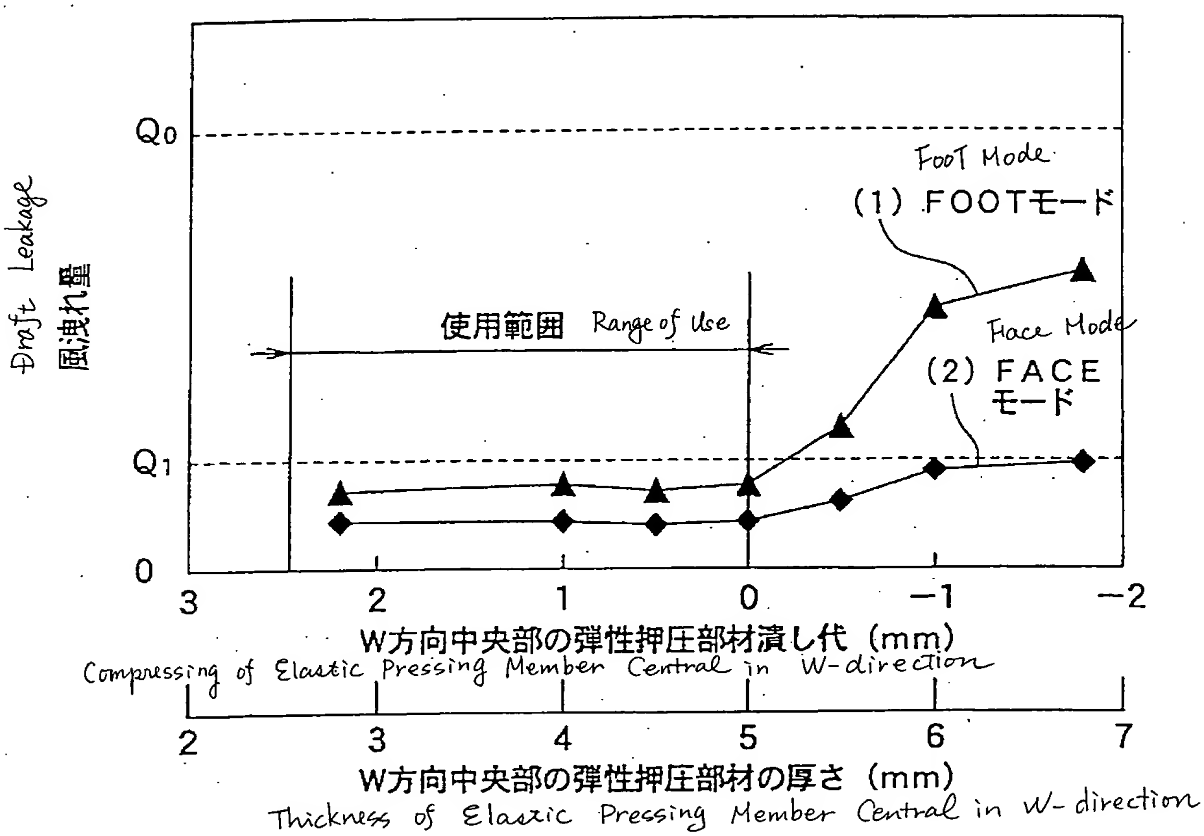
26e
26h
26j
26a
26k
26c
26d
26j

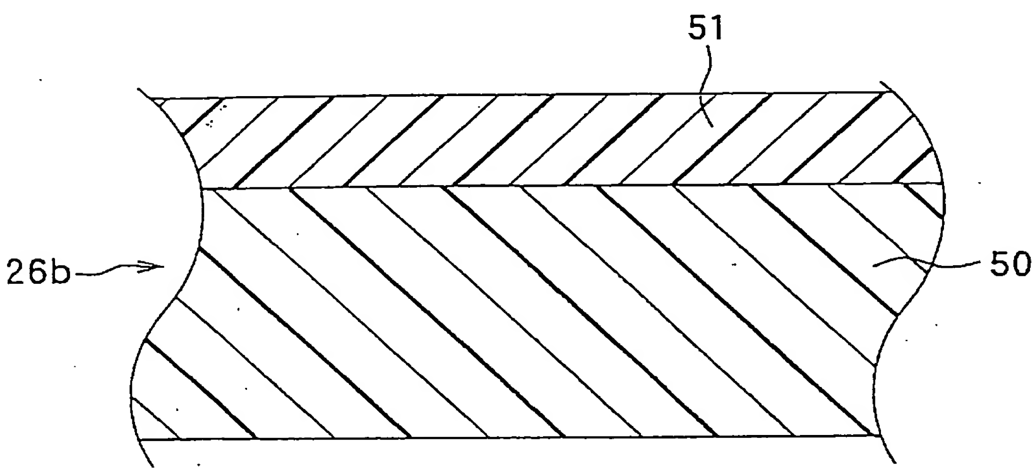
【図６】 {Fig. 6}


A－A断面
22b
26e
22
26b
26
22a
D
26e
26e
22b
26j
28
122
26a
L1
26k
b
W
26j
L2
27
121
L1＞L2
22：フェイス開口部（空気通路）Face Port (Air Passage)
22a：格子 Grill Member
22b：周縁シール面 Edge Seal Face
26：スライドドア Sliding Door
26a：ドア基板 Door Plate
26b：フィルム部材 Film Member
26e：弾性押圧部材 Elastic Pressing Member

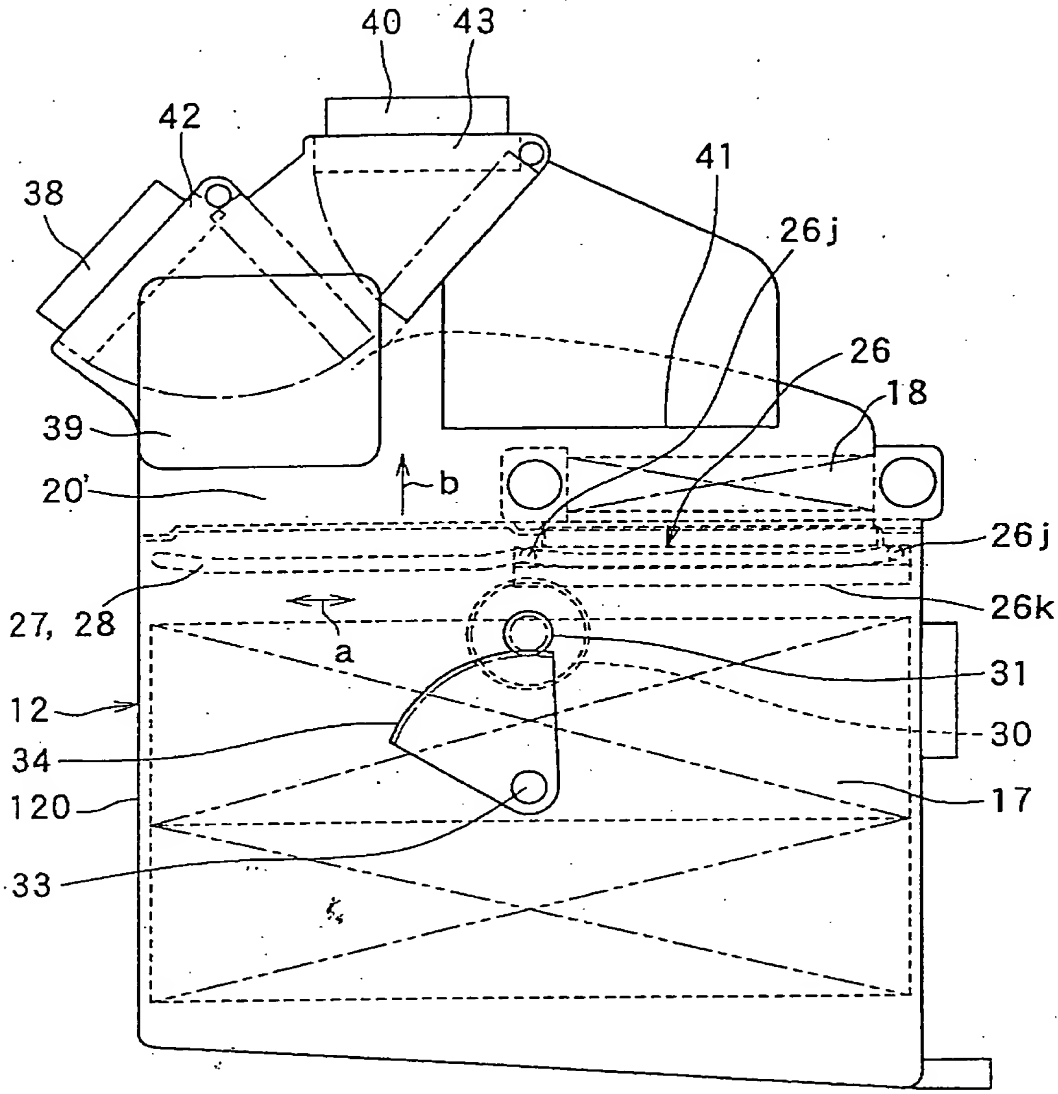
【図７】 {Fig.7}




【図８】 {Fig.8}



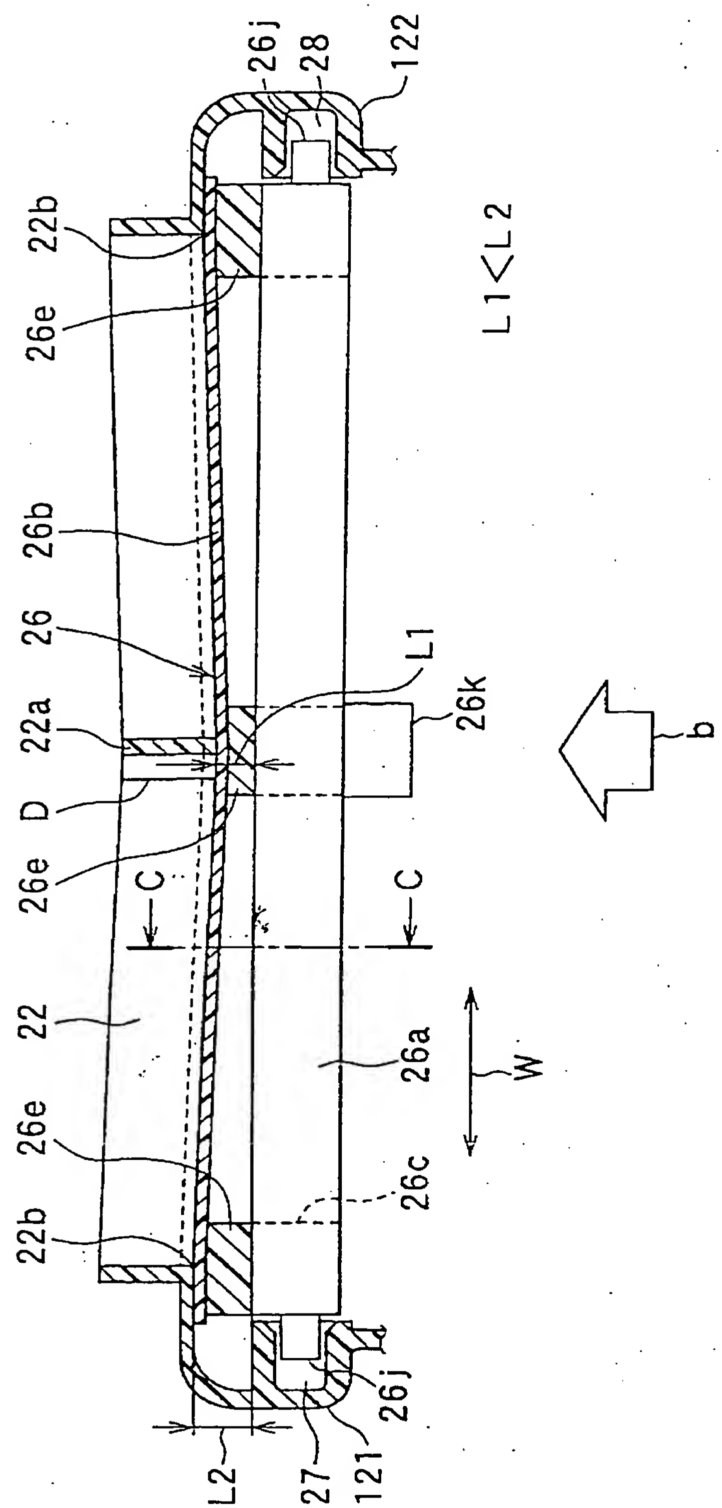
【図９】〔Fig.9〕



【図１０】〔Fig.10〕

A－A断面

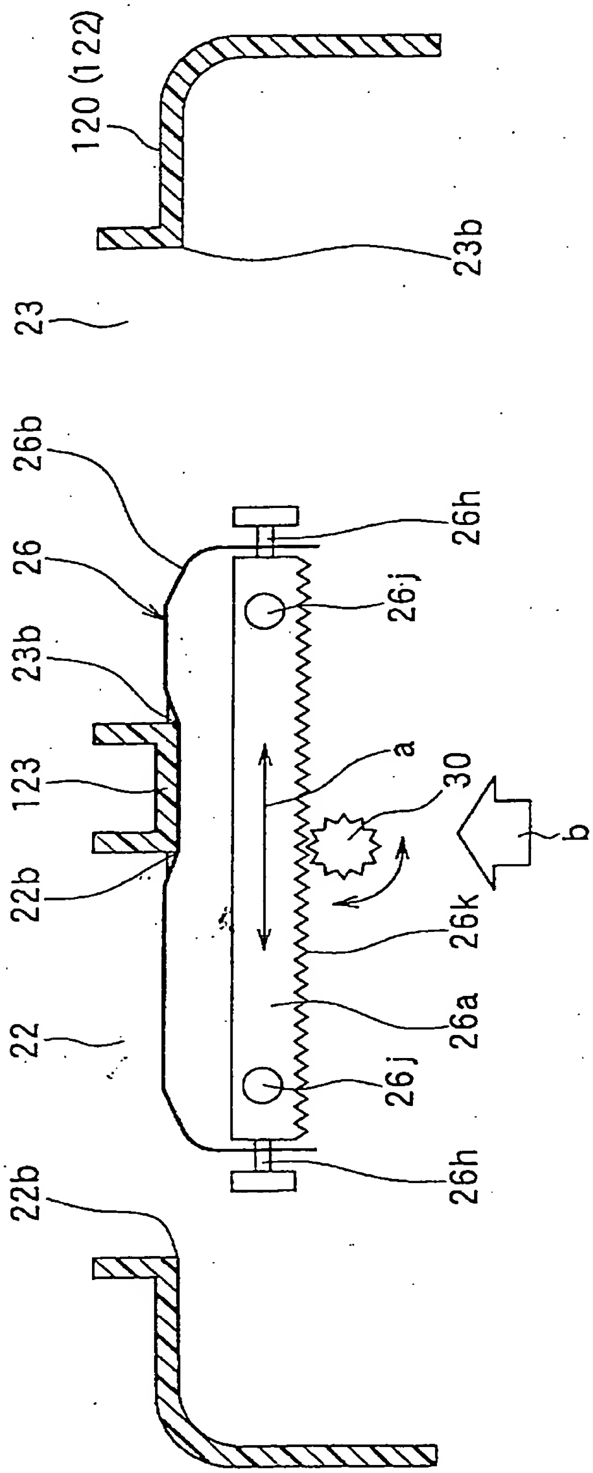
A-A Cross Section



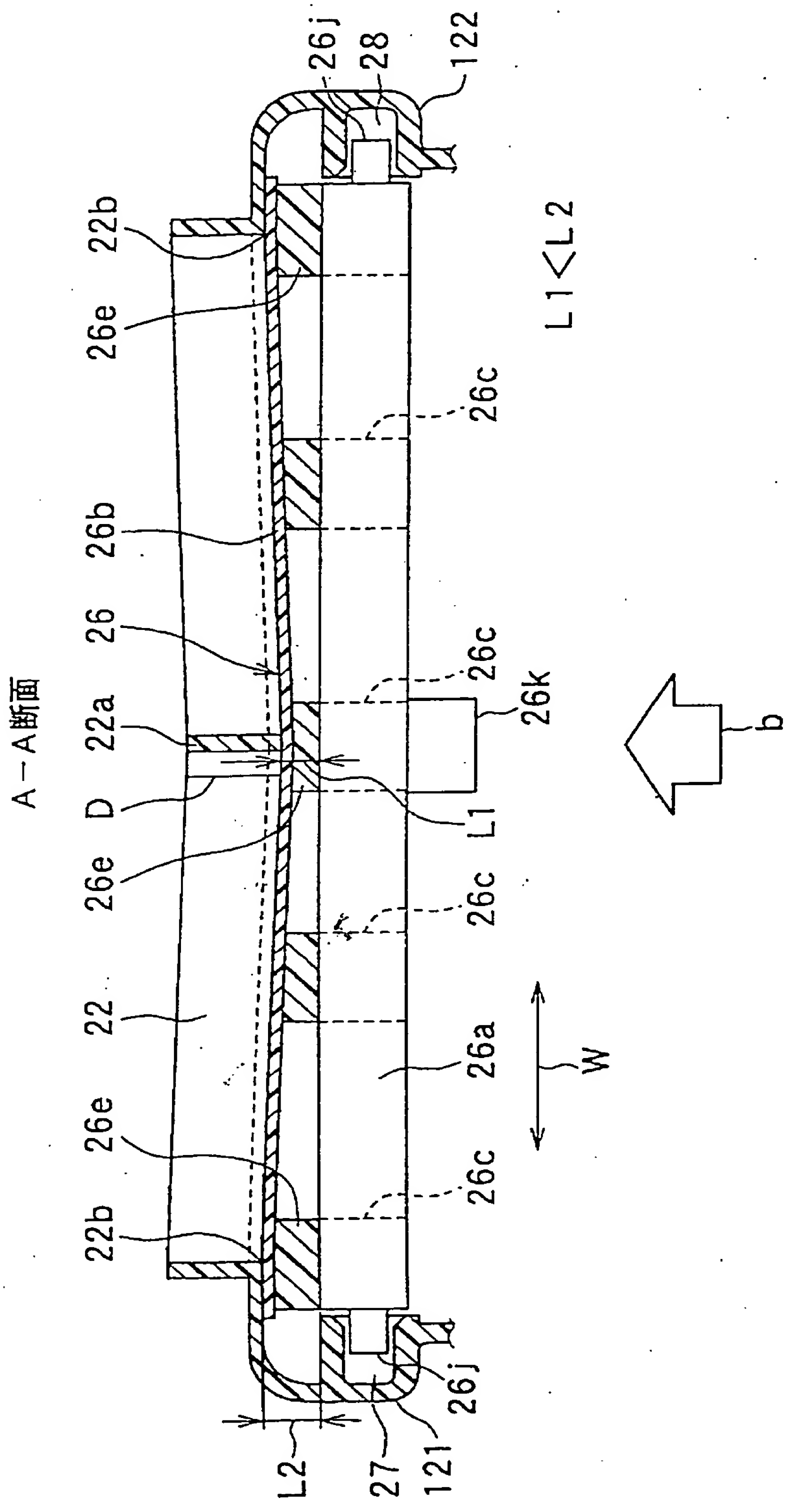
【図１１】〔Fig.11〕

C-C Cross Section

Ｃ－Ｃ断面



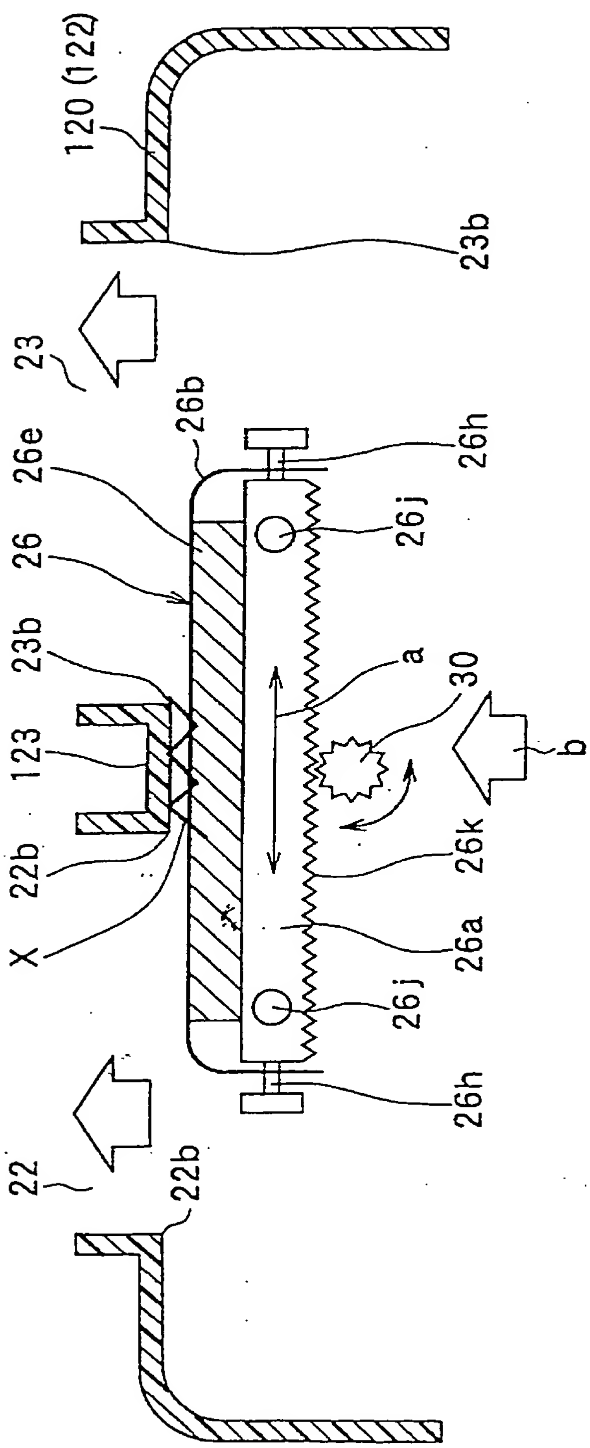
【図１２】 {Fig. 12}


A－A断面
22b
26e
26b
26
22a
D
26e
22
26e
22b
L2
27
121
26j
26j
28
122
L1<L2
26c
26c
26k
L1
26c
26a
W
26c
b

【図１３】 [Fig.13]

B－B断面

B-B Cross Section



[Name of the Document] ABSTRACT OF DISCLOSURE

[ABSTRACT]

[OBJECT]

In an air passage switching device using a film-type sliding door, the production of extraneous noise (popping noise and crackling noise) by a film member is prevented.

[MEANS FOR ACHIEVING THE OBJECT]

A grill member 22a is provided in an air passage 22 so as to extend parallel with the sliding direction of a sliding door 26 and divide an opening of the air passage into a plurality of smaller openings. The sliding door 26 has a film member 26b, a door plate 26a supporting the film member 26b, and elastic pressing means 26e for pressing the film member 26b against edge seal faces 22b of the air passage 22 and an end face of the grill member 22a. A spacing L1 between the door plate 26a and the end face of the grill member 22a, which is central in a direction W orthogonal to the sliding direction of the sliding door 26, is made larger than a spacing L2 between the door plate 26a and the edge seal faces 22b, which are at the sides of the air passage.

[Selected Figure] FIG. 6